NATIONAL OCEANIC and ATMOSPHERIC ADMINISTRATION

NOAA's Ground Segment Project Plan For Participation in the Initial Joint Polar-orbiting System

June 1999

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Executive Summary

The Polar-orbiting Operational Environmental Satellite (POES) program is managed by the National Environmental Satellite, Data and Information Service (NESDIS), organizationally part of the National Oceanic and Atmospheric Administration (NOAA), within the Department of Commerce (DOC). Meteorological data has been collected by POES satellites for more than thirty years and is provided to the national and international meteorological community free of charge or at cost.

In November 1998, NOAA signed an agreement with the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) for cooperation in supporting the Initial Joint Polar System (IJPS). This agreement represents the culmination of discussions between the two parties over the past decade to consider alternatives for sharing costs of collecting meteorological data from space. The IJPS comprises two series of independent, but fully coordinated, Polar-orbiting satellite systems. In support of the IJPS, NOAA will provide and operate the POES satellites NOAA-N and NOAA-N' in afternoon orbits under control of the POES Ground Segment. EUMETSAT will develop, provide and operate Meteorological Operational (MetOp) satellites MetOp-1 and MetOp-2 in mid-morning orbits under control of the EUMETSAT Polar System (EPS) ground segment. The IJPS Agreement calls for the joint exchange of all satellite data collected and cross-support between ground segments during satellite operations. For NOAA, the IJPS Agreement also provides a replacement for the NOAA morning satellite.

Based on the IJPS Agreement, NOAA and EUMETSAT are currently preparing a "Program Implementation Plan (PIP) for the cooperation between NOAA and EUMETSAT on the IJPS." To fully implement the IJPS Agreement, the PIP identifies those ground segment requirement to be met by NOAA. In FY 1998, NOAA completed a study to define all impacts on the current ground segment to support IJPS operations. This study culminated in program cost estimates that were reflected in the NOAA budget request. Funding for updating NOAA's ground segment to support the IJPS Agreement is presently scheduled to start in FY 2000.

This plan describes:

1) the roles and responsibilities within NESDIS,
2) milestones and schedules, and
3) planned acquisition activities for acquiring, installing and testing all required upgrades to the POES Ground Segment to support the IJPS Agreement.

Table of Contents

Section **Page**

Section **Page**

List of Figures

List of Tables

1. Introduction

The National Environmental Satellite, Data, and Information Service (NESDIS), part of the National Oceanic and Atmospheric Administration (NOAA), is responsible for establishing and administering funding for civil operational environmental satellite systems. As part of its planning to transition to a fully integrated international satellite system, NOAA has entered into an agreement with the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) for participation in the Initial Joint Polar System (IJPS) (hereinafter referred to as the "IJPS Agreement") [Reference 1]. In the IJPS Agreement, NOAA and EUMETSAT agree to operate their Polar-orbiting satellites in a manner beneficial to both parties and the world's meteorological community. The IJPS Agreement also commits NOAA to processing and distributing the EUMETSAT satellite information as the NOAA morning operational satellite.

This plan, NOAA's Ground Segment Project Plan for participation in the IJPS, is prepared by NESDIS in support of these responsibilities.

1.1 Background

As part of the basic architecture for collecting satellite data in support of NOAA's current national and international commitments for providing global environmental data, NESDIS operates and maintains the Polar-orbiting Operational Environmental Satellite (POES) system. NESDIS manages and operates the POES system through its operational ground segment while acquiring replacement satellites, launch vehicles and launch services through interagency agreements with the National Aeronautics and Space Administration (NASA). The POES Ground Segment provides for the reception of environmental data from satellite instruments, processes and displays satellite health and safety information, generates schedules and commands for control of satellite subsystems, processes information from satellite instruments, generates environmental products, and distributes selected products to users.

Since 1978, the POES system has operated with a two satellite constellation in circular, near-polar, sun-synchronous orbits. The current system is operating with NOAA-14, an advanced TIROS-N (ATN) fourth-generation satellite launched on December 30, 1994, in the primary afternoon (13:30) orbit with an ascending equatorial crossing-time. NOAA-15, an ATN fifth-generation satellite launched on May 13, 1998, is operating in the morning (07:30) orbit with a descending equatorial crossing-time. The remaining fifth-generation satellites that are currently being acquired by NOAA for the POES system are designated as NOAA-L, -M, -N, and -N'. These satellites incorporate new and upgraded environmental instruments and reliability design improvements to extend their on-orbit mission life to three years. NOAA-N and -N' continue to use the same spacecraft baseline, upgraded with spacecraft solid state recorders and environmental instruments.

To extend the availability of the fifth-generation POES satellites, NOAA has entered into the IJPS Agreement with EUMETSAT to jointly share operational satellite responsibilities and the

environmental data collected by the system. The IJPS comprises two independent, but fully coordinated, Polar-orbiting satellite systems. Each independent system consists of two satellites flown consecutively under the control of its respective ground segment. In support of the IJPS Agreement, NOAA-N and -N' will be flown consecutively in a Polar orbit with an afternoon equatorial crossing time. EUMETSAT, working together with the European Space Agency (ESA), will develop a Meteorological Operational (MetOp) series of satellites to be flown in a Polar orbit with a mid-morning equatorial crossing time. The MetOp satellites constitute the space segment of the EUMETSAT Polar System (EPS).

1.2 Purpose

The purpose of this project plan is to document approved POES Ground Segment Development Phase activities, as defined in Section 4.1.2 of this plan, to provide guidance for their implementation, and to identify resource levels for updating the ground segment in support of NOAA's participation in the IJPS with EUMETSAT.

1.3 Scope

The scope of this project plan addresses POES Ground Segment requirements for budget year FY 2000 and planning years FY2001 through FY 2004.

1.4 Milestones

Scheduled activities and resource phasing reflected in this plan are based on the current launch schedules for MetOp-1 and MetOp-2, and NOAA-N and -N' as shown in Table 1.

Satellite	Planned Launch	Comments
MetOp-1	2nd Quarter 2003	Commissioning period nominally 6 months
NOAA-N	4th Quarter 2003	Commissioning period nominally 3 months
MetOp-2	1st Quarter 2008	Commissioning period nominally 6 months
NOAA-N'	1st Quarter 2008	Commissioning period nominally 3 months

Table 1 Launch Schedule

1.5 Document Organization

This document is organized into six major sections and two appendices. Section 1 introduces the IJPS and the role of NOAA's POES System. Section 2 contains a brief description of the IJPS mission and NOAA's responsibilities for supporting system operations. In response to IJPS requirements, Section 3 describes planned acquisition tasks for updating the POES Ground Segment. Section 4 describes the management structure for planning and scheduling acquisition tasks, preparing deliverable documentation, and defining and controlling resources required to meet NOAA's commitments to the IJPS Agreement. Section 5 describes the planned level of test and evaluation activities required to establish the POES Ground Segment baseline for its operation with the EPS. Section 6 addresses risks associated with implementing planned tasks.

Appendices to this document provide additional information on ground segment requirements and project schedules.

1.6 Reference Documents

1. Agreement between the United States National Oceanic and Atmospheric Administration and the European Organization for the Exploitation of Meteorological Satellites on an Initial Joint Polar-orbiting Operational Satellite System, initialed in July 1998.

2. Barbieri, Louis P. and Callicott, William, *The NOAA/POES 2003 System Definition Study*, The Boeing Company, April 30, 1998, Final Draft.

3. B.A. Banks and F.C. Holt, *NESDIS Guide to Satellite Products and Services Implementation*,1994, NOAA Technical Memorandum NESDIS 38.

4. Configuration Management Plan, July 1 1998, NOAA NESDIS Information Processing Division, Central Satellite Data Processing Center, Computer Science Corporation, Laurel, MD

5. Memorandum of Agreement Between the National Aeronautics and Space Administration and National Oceanic and Atmospheric Administration of the Department of Commerce for Cooperation in the Polar-orbiting Operational Environmental Satellite Program, April 1998.

6. NAO 208-3, National Oceanic and Atmospheric Administration, 4 October 1994, Major Systems Acquisitions, Washington DC: U.S. Department of Commerce.

7. Program Implementation Plan (PIP) for the Co-operation Between NOAA and EUMETSAT on the IJPS Program, (Draft), July 1998.

8. POES Program Plan, TBD.

1.7 Document Maintenance

This project plan will be updated annually in support of the NOAA budget process.

2. IJPS Mission

In response to the IJPS Agreement, the "Program Implementation Plan (PIP) for the Co-Operation Between NOAA and EUMETSAT on the IJPS Program" identifies specific mission support requirements for both the POES and EPS systems [References 1 and 7]. This section provides a brief description of the IJPS mission, operations concept and NOAA's responsibilities in supporting the IJPS.

2.1 Mission

The general mission objective of the IJPS is to collect and exchange between NOAA and EUMETSAT and disseminate to users global environmental data to support operational meteorological and environmental forecasting and global climate monitoring. Primary mission objectives are the collection and dissemination of global sounding and imagery data. This will be accomplished by the IJPS satellites, NOAA-N and -N' and MetOp-1 and MetOp-2, carrying a common set of environmental instruments as shown in Figure 1. In addition, NOAA-N and -N' will carry a Solar Backscatter Ultra-Violet Spectral Radiometer/2 (SBUV) instrument in the afternoon orbit. MetOp-1 and MetOp-2 will carry the following additional instruments in the mid-morning orbit:

- Infrared Atmospheric Sounding Interferometer (IASI)
- Advanced Scatterometer (ASCAT)
- Global Navigation Satellite System Receiver and Atmospheric Sounding (GRAS)
- Global Ozone Monitoring Experiment (GOME)

Common Environmental Instrument Set

- Advanced Very High Resolution Radiometer/3 (AVHRR)
- High Resolution Infrared Radiation Sounder/4 (HIRS)
- Advanced Microwave Sounding Unit/A1 and A2 (AMSU)
- Microwave Humidity Sounder (MHS)
- ARGOS/Data Collection System/2 (DCS/2)
- Search and Rescue Satellite (SARSAT) Aided Tracking System
- Space Environment Monitor (SEM)

Figure 1 Common Environmental Instrument Set

Environmental data collected by IJPS satellites will be both stored on-board satellites for downloading to their ground segment and broadcast in real-time for reception by local receiving stations, during a satellite overpass. The global environmental data collected and stored on-board IJPS satellites, will be provided to meteorological services at the raw data level within 2 hours and 15 minutes of their instant of observation [Reference 7, para 1.5.3].

2.2 Operations Concept

In support of IJPS operations, the POES and EPS satellites, including the instruments they carry, will be operated and controlled by NOAA and EUMETSAT through their respective ground segments. IJPS operations are to be conducted continuously 24 hour per day, seven days per week in support of on-orbit satellites. This requires that adequate capability exist to adapt to anomalous satellite performance and to provide backup capability for ground segment elements in case of failures or downtime for maintenance or repair. Global and housekeeping data received by the POES and EPS ground segments during operations with their respective satellites will be archived and made available to NOAA and EUMETSAT as required to implement the IJPS mission.

In addition to operating and controlling their own satellites, POES and EPS ground segments will provide blind orbit cross-support for commanding access and housekeeping telemetry acquisition to/from operational satellites not in view of their respective ground segments. At the altitude for Polar satellites the orbital period is nominally 102 minutes, permitting just over 14 complete earth orbits per day. Of these orbits, not all satellite orbital passes will be within the field of view of its dedicated ground stations. While each satellite provides direct broadcast of real-time environmental data as it passes in view of ground stations world wide, it also stores mission data to be downloaded as scheduled by its dedicated ground station when in its field of view. For current POES blind orbit operations, satellite housekeeping telemetry data is collected from the *Lannion Centre de Meteorologie Spatiale* in France. In the IJPS era, NOAA and EUMETSAT will provide blind orbit support to each other for both satellite commanding and telemetry operations. When providing blind orbit cross-support, the ground segment will be operated in a communications throughput (bent-pipe) mode. Also provided during blind orbit operations will be the collection, storage, and timely exchange of global data between NOAA and EUMETSAT.

The POES Ground Segment will continue to receive, process and distribute direct broadcast satellite information from both the POES and the EPS satellites (the operational MetOp satellite functioning as the morning NOAA satellite).

A single-point communications interface for each system will be established by a communications link between the POES and EPS satellite systems. This link will be defined and implemented by NOAA and EUMETSAT to meet IJPS mission operations requirements.

2.3 NOAA Responsibilities

In support of the IJPS, NOAA's primary responsibility is to provide on-orbit satellite operations with NOAA-N and then NOAA-N' in the 2004 through the 2011 time period. NOAA will continue to support its satellites with the current baseline POES Ground Segment. Planned upgrades in satellites will be reflected in launch-to-launch modifications/upgrades and implemented in accordance with the memorandum of agreement between NASA and NOAA [Reference 5]. Information on satellite and ground segment changes will be shared with EUMETSAT through the procedures established in Section 7.5 of the PIP covering the Coordination Baseline for the IJPS.

In addition, NOAA will support on-orbit satellite operations for MetOp-1 and then MetOp-2 with the POES Ground Segment. NOAA will also share all satellite data collected by its ground segment from POES and MetOp satellites. All requirements as defined in Section 2.6 of the PIP, listing NOAA's ground segment requirements, are summarized in a Level 1 Requirements Matrix included in Appendix A of this plan. The allocation of PIP requirements to ground segment elements is also identified in the matrix. All changes proposed and implemented in the POES Ground Segment will be reviewed and coordinated with EUMETSAT in accordance with the configuration management procedures established in Section 7.6 of PIP.

In recognition of NOAA's responsibilities in support of the IJPS, the remainder of this plan will discuss planned upgrades to the POES Ground Segment and NOAA's approach for planning and implementing upgrades in support of IJPS operations.

3. Ground Segment Tasks

This section provides a description of approved tasks to upgrade the POES Ground Segment to support IJPS operations.

3.1 POES Ground Segment Elements

The baseline POES Ground Segment for supporting fifth-generation POES ATN satellites consists of Command and Data Acquisition (CDA) stations located at the Fairbanks, Alaska, and Wallops, Virginia, and at the Satellite Operations Control Center (SOCC) and Central Environmental Satellite Computer Center (CEMSCS) located in Suitland, Maryland. The Fairbanks and Wallops CDAs serve as operational backup facilities to the SOCC for satellite command and control functions. Archive functions are located at the CDAs, SOCC, CEMSCS, Satellite Active Archive (SAA) located at the CEMSCS, and at the National Climatic Data Center (NCDC) at Suitland, Maryland, and Asheville, North Carolina. Communications services are provided to link POES operational sites with each other, and with its community of national and international users.

3.2 Ground Segment Requirements

At the request of the NESDIS POES Program Manager, NASA completed a study on the baseline POES Ground Segment for the 2003 time period [Reference 2]. This study identified potential changes to the ground segment that were considered necessary to support the MetOp satellites and to exchange global satellite data with the EPS as described in Section 2 of this plan. These changes were required to support the following significant characteristics of the MetOp satellites:

1. X-band Global data link transmitting at 70 Mbps. (NOAA-N and -N' transmit at 2.66 Mbps)
2. Data handling system based on CCSDS formats. (NOAA-N and -N' use Goddard Satellite Tracking and Data Network, GSTDN, formats)
3. Quadrature Phase Shift Keying (QPSK) for data transmissions. (NOAA-N and -N' use Binary Phase Shift Keying) (BPSK)
4. Additional environmental instruments which include the IASI, ASCAT, GRAS and GOME.
5. Full 1 Km AVHRR data per orbit. (NOAA-N and -N' 11 minutes Local Area Coverage, LAC, per orbit)

Proposed acquisition projects are grouped by the site location/ground segment element where they will be implemented. Proposed upgrades and modifications will be added to the ground segment while maintaining operational support for NOAA-N and -N'. NOAA's organizational responsibilities for implementing acquisition projects is discussed in Section 4 of this plan.

3.3 FCDA Station- MetOp X-band Capability

NOAA is currently upgrading both the Fairbanks CDA (FCDA) and Wallops CDA (WCDA) stations with the installation of 13 meter antennas. These antennas are capable of operating at S-band, L-band and X-band frequencies. However, only the S-band and L-band frequencies will be implemented for operations with NOAA-N and -N'. NESDIS is also upgrading the VHF receive antennas at FCDA and WCDA stations.

An acquisition task will be initiated to upgrade the antenna(s) at Fairbanks to activate its/their inherent X-band capability. This will involve installing the necessary elements (receivers, diversity combiners, demodulation, bit synchronizers, cables, etc) to complete the receive path in the antenna system. This task will be scheduled to allow unit testing of the antennas to be completed and the X-band capability to be available to support launch readiness activities starting six months before the launch of MetOp-1.

An acquisition task is also being considered to provide a suitcase test unit for use in validating the NOAA satellite interface with the EPS ground segment during development and pre-launch test activities. This task will be scheduled to allow development and unit testing of the EPS antenna to be completed and the antenna to be available to support launch readiness activities starting six months before the launch of MetOp-1.

3.4 CDA & SOCC - MetOp Data Acquisition and Transfer

The MetOp Data Acquisition and Transfer task will implement satellite operations at the FCDA and WCDA stations and at the SOCC. All satellite operations are scheduled and executed under the control of the Polar Acquisition and Control System (PACS) at the SOCC, or backup systems located at the CDAs. An acquisition task will be initiated to conduct development efforts to size, select, acquire, install and test all upgrades to the CDAs and SOCC.

The CDA's will be upgraded to support the new data formats and rates from the MetOp satellites. At the FCDA station, this will include implementing the X-band RF path between the antenna and data handling system; a data buffering capability to accommodate the differences in data rates between the MetOp satellites and the data handling systems inherent in the POES CDAs; a CCSDS transmission transfer and error tracking and control capability; a rolling storage (archive) to provide seven (7) days of the satellite data acquired at the station, and upgrades to the data switching and intra-site communications to implement the automated configuration and data flow required to implement IJPS operations under control of the PACS at the SOCC. At the present time, the WCDA station will only be updated to receive the MetOp real time HRPT data stream and direct it to CEMSCS in support of the Coast Watch mission. Similar modifications, as implemented at the FCDA station, could be installed at the WCDA station should additional support requirements be approved.

This acquisition task will also implement a NOAA communications interface with inter and intra-systems communications. The inter-system interface will be collocated at the SOCC, and at its

backup locations as determined in a NOAA communications study, and will implement the NOAA interface for all global and housekeeping information exchanges between NOAA and EUMETSAT to obtain the full benefits of the IJPS mission. Upgrades to the intra-system communications required to support the IJPS mission will also be included as part of this task. This task will provide for the design, procurement and implementation of the NOAA communications interfaces to allow the SOCC to schedule and control the exchange of satellite data from the CDAs to SOCC, CEMSCS and EUMETSAT and from EUMETSAT to SOCC and CEMSCS. This task will be scheduled to allow unit testing of the NOAA communications interfaced to be complete and available to support launch readiness activities starting six months before the launch of MetOp-1.

The acquisition task will also implement upgrades to PACS and SOMS capabilities to support the new planned operations for the MetOp satellites. This task will provide for the design, procurement and implementation of PACS and SOMS software upgrades to allow the SOCC to schedule and control the exchange of satellite data from the CDAs through the NOAA communications interface to EUMETSAT and CEMSCS and from EUMETSAT to the SOCC and CEMSCS. The upgrades for the SOCC will be implemented at the CDAs to allow them to function as the backup to the SOCC. This task will be scheduled to allow unit testing of the PACS and SOMS upgrades to be completed and available to support launch readiness activities starting six months before the launch of MetOp-1.

3.5 CEMSCS/SAA - Data Processing, Distribution and Storage

Acquisition tasks will be planned and implemented to update the Polar Data Processing System (PDPS) and the SAA, both located within CEMSCS, to ingest, process and store the data streams received from both the EPS Ground Segment and forwarded to NOAA (all MetOp and NOAA blind orbits) and from NOAA CDAs (NOAA orbits). The CEMSCS PDPS consists of the Front-End Processor (FEP), which includes the data ingest and Pre-Product processor (PPP) for Level 1 product generation, and numerous Product Processing Systems (PPS) for generation of Level 2+ products. (Note definitions of Level 1 and 2 products is included in the Glossary). The CEMSCS SAA consists of hardware and software to support providing POES satellite data sets near-line for direct user access through the internet. The SAA system copies the NOAA Level-1b data sets to a robot tape system which can be be accessed through the internet to browse and acquire satellite data.

3.5.1 Upgrades to the Front End Processor, Pre-Product Processor, Product Processing Systems and Satellite Active Archive Systems

An acquisition task will be initiated to size and procure a new Front End Processor (FEP) to support functions of data ingest of the MetOp and POES satellite data streams as they are forwarded to CEMSCS from the EPS Ground Segment via the NOAA communications interface and from the CDA stations, presently via the SOCC. The MetOp satellite data stream will be in 256 second duration granules, processed through the communications links in a first in/first out order, “pipeline” fashion. POES satellite data, acquired by the EPS Ground Segment, will be forwarded to the CEMSCS in a format without processing of the data other than that related to the Ground-to-Ground transmission. The FEP will be selected to allow for pipeline (granule) processing of the data stream

and to take advantage of existing commercial designs with an operating system and available application programs that are compatible with the evolving architecture of CEMSCS. Porting of existing data ingest and Level 1 processing software to the FEP will be an overall development goal. The FEP development will be scheduled to be completed by December 2002 to support ingesting the MetOp and POES satellite data streams (from the EPS GS) and producing Level 1a data sets which contain all of the MetOp and NOAA instrument data in support of production of Level 1b and Level 1c data sets by the Pre-Product Processor (PPP).

An acquisition and software development task will be initiated to procure and develop a Pre-Product Processor (PPP) to access the pipeline Level 1a data sets from the FEP and pipeline process these data to Level 1b or Level 1c data sets. Porting of existing pre-processing software for the AVHRR, HIRS, and AMSU instruments to the new PPP, where applicable, will be an overall development goal. This task will include generation of both a MetOp full resolution (1km) AVHRR dataset along with a reduced resolution (4km) AVHRR dataset compatible with NOAA-N and N' AVHRR GAC data sets. In addition, incorporation of EPS Ground Segment software for pre-processing of the MetOp additional instruments (IASI, ASCAT, GOME, and GRAS) to Level 1b or Level 1c, where applicable, will also be an overall development goal. This latter work will be implemented on a a priority basis as requirements dictate and at the level supported in the NESDIS budget. The PPP development task will be scheduled to be completed by December 2002 to support accessing the Level 1a data sets from the FEP and producing Level 1b data sets for further processing by the product generation systems.

A software development task will be initiated to upgrade the numerous Product Processing Systems (PPS) to process the MetOp Level 1b or Level 1c data sets and produce the baseline suit of morning products, as well as providing for the processing of the NOAA-N and N' data. With pipeline processing of the Level 1data sets, changes in the data interface of each product processing system will be required to allow for Level 1 access. Additionally, for those product systems requiring further pipeline processing to meet operational timeliness requirements, their existing software will have to be altered to derive products from the MetOp mid-morning satellite. This task will include modifying the existing Ozone Operational Processing System to process the GOME data to derive products. This task will be scheduled to be completed and ready to support launch readiness activities starting six months before launch of the MetOp-1 satellite.

An acquisition task will be initiated to upgrade the capabilities of the CEMSCS and SAA to store and archive the large volumes of data associated with MetOp satellite. This will require updating the current tape storage systems at CEMSCS and related support systems to manage the archive products in granular increments and the metadata information that describes the data holdings accordingly. This task will be scheduled to allow unit testing of the upgrades to the CEMSCS and SAA prior to launch of the MetOp-1 satellite.

3.5.2 Modifications to Product Processing Systems for Additional Mid-Morning Products

A software development task will be implemented to modify those PPS which, due to the mid-morning orbit of the MetOp satellite, can now provide a second set of operational products(i.e.

Imagery, Aerosols, Vegetation Index). These additional products will allow for extended temporal coverage, detection of diurnal variations and/or provide a viable back-up to the afternoon satellite suite of products. An acquisition task will also be initiated for the PPS to size and procure additional processing capability (workstations) required in CEMSCS for support of this additional product generation. This task will be scheduled to allow for unit testing of the PPS modifications prior to launch of the MetOp-1 satellite.

3.5.3 Modifications to Product Processing Systems for Application of Full Orbital AVHRR 1 Km Data

A software development task will be initiated to modify those PPS which can improve their product suites due to the access to global high-resolution AVHRR data from the MetOp satellite. The MetOp satellite will acquire and store the full AVHRR instrument data a 1 km resolution for each complete orbit. This is unlike the POES satellites where AVHRR data is stored in 1) limited 1 km Local Area Coverage (LAC) data sets for short periods of time and 2) orbital 4 km Global Area Coverage (GAC) data sets. An acquisition task will also be initiated for the PPS to size and procure additional processing capability (workstations) required in CEMSCS for support of this enhanced product generation. This task will be scheduled to allow for unit testing of the PPS modifications prior to launch of the MetOp-1 satellite.

3.5.4 Development of New Product Processing Systems for Additional MetOp Instruments

A software development task will be initiated to develop new Product Processing Systems, as required, for the additional instruments onboard the MetOp satellites: the IASI, ASCAT, GOME, and GRAS. This work will be implemented on a priority basis as requirements dictate and at the level supported in the NESDIS budget. Incorporation of EPS Ground Segment software, for product processing of these instruments where applicable, will be an overall development goal. An acquisition task will also be initiated to size and procure additional processing capability (workstations) required in CEMSCS for support of this additional product generation. The procurement of these processing capabilities will be scheduled to support the early integration by OSDPD of EPS-provided software where applicable and/or the development work by ORA for generation of an operational product processing system. This task will be scheduled to allow for unit testing of new PPSs prior to launch of the MetOp-1 satellite.

3.6 Communications

3.6.1 NOAA Communications Sizing Study

An acquisition task has been initiated to study, simulate and size the required communications services necessary to retrieve satellite data to support NOAA's mission. The output of this study will characterize the required services in terms of transmission budgets, error correction protocols, performance, utilization rates, availability, cost. The study results will be used NOAA to specify and contract for services to retrieve and transfer satellite information received by the EPS and the FCDA station.

3.6.2 Inter-System Communications

An acquisition task will be initiated to provide the communications services necessary to support blind orbit operations with NOAA-N and -N' and to retrieve environmental data collected by MetOp-1 and then MetOp-2 satellites to support NOAA's needs for mid-morning satellite data as defined in the NOAA Communications Sizing Study. It will include communications for wide band data, narrow band cross support and coordination functions. This service is required 6 months prior to launch of the first MetOp satellite.

3.6.3 Intra-System Communications

An acquisition task will be initiated to provide the communications services upgrades between the ground segment site locations to support the higher flow data rates necessary to exchange MetOp-1 and then MetOp-2 satellite data as defined in the NOAA Communications Sizing Study. This service will upgrade the data exchange rate between the CDA stations and the NOAA communications interface at the SOCC, and between the single point communications interface at the SOCC and the CEMSCS. This service is required 6 months prior to launch of the first MetOp satellite.

3.7 Off-Line Archive

NCDC will implement an upgrade program to store, archive, and retrieve the large volumes of data associated with the MetOp satellite. This will require updating the current tape storage systems at NCDC and related support systems to manage the archive products in granular increments and the metadata information that describes the data holdings accordingly. This task will be scheduled to allow unit testing of the upgrades to NCDC prior to launch of the MetOp-1 satellite.

4. Project Management

NESDIS is responsible for the management of operational satellite systems assigned to NOAA, within the Department of Commerce. The key NESDIS organizational elements responsible for supporting satellite operations are as shown in Figure 2. NOAA's participation in the IJPS is being planned, programmed and implemented within the structure of the POES program. Management of the POES program is assigned to the POES Program Manager, organizationally part of the NESDIS Office of Systems Development (OSD).

This section presents the plan for the overall management of upgrades to the POES Ground Segment to support the IJPS Agreement. It describes the management structure for planning and implementing project tasks; lists planned project reviews; provides a project schedule; lists deliverable documentation, and identifies the funds required to meet NOAA's commitments to the IJPS Agreement.

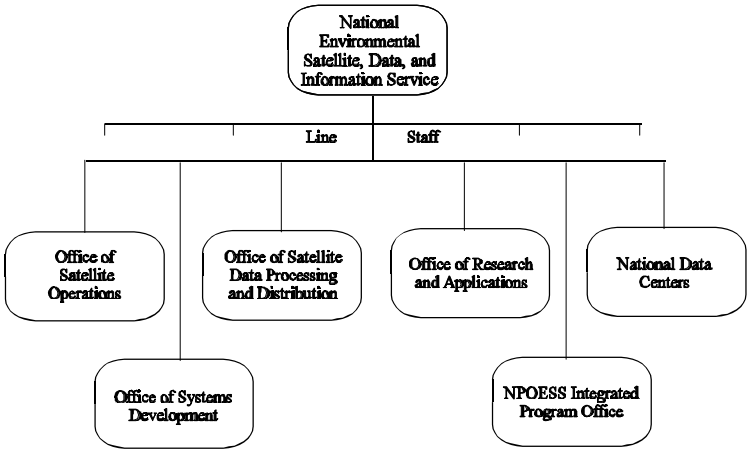

Figure 2 NESDIS Organization Chart

4.1 POES Program Management

The POES Program Manager is responsible for implementing the total program throughout its life cycle, including research and development, definition of program requirements, operations and operational support, including facilities, and delivery of user products. The program manager establishes program requirements, milestones and schedules, and assembles, justifies, and presents program and budget information for implementing approved Polar programs. Management of the POES program within NESDIS is described in more depth in the POES Program Plan [Reference 8]. The POES Program Manager's responsibilities for acquisition programs are based on the organizational responsibilities defined in "NOA 208-3 - Major Systems Acquisition," [Reference 6].

The POES Program Manager has a staff of three technical staff members supporting program management activities. They are the MetOp Coordinator, Polar Product Manager, and a POES Systems Engineer as shown in Figure 3.

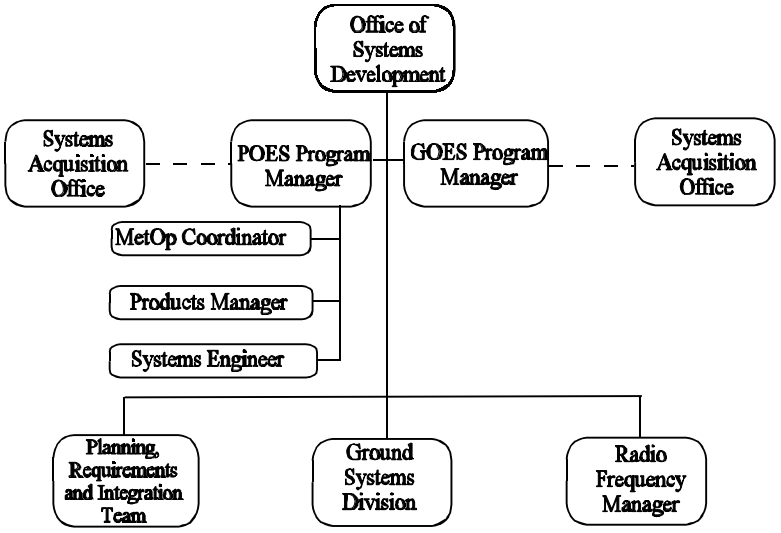

Figure 3 Office of Systems Development

In support of planning and implementing NOAA's responsibilities for the IJPS Agreement, the POES staff have been assigned the following responsibilities:

MetOp Coordinator

- Preparation and coordination of the PIP
- Preparation and coordination of the Joint Operations Rules and Procedures (JORP) Document
- Preparation and coordination of Interface Requirements Documents (IRDs)
- Preparation and implementation of the Ground Segment Project Plan
- Leads MetOp Ground Systems Working Group
- Preparation of NOAA's budget input for upgrading the POES Ground Segment
- Coordination of configuration changes between NOAA and EUMETSAT.

Polar Products Manager

- Plans for continuity of Polar Products
- Plans and coordinates the evolutionary development of new products
- Preparation of NOAA's budget input for product processing in the 2003 time period
- Product verification and validation

POES Systems Engineer

- Coordinates on satellite to ground IRDs
- Coordinates on ground segment upgrades
- Monitors that system requirements are being satisfied

4.1.1 MetOp Ground Systems Working Group

As part of the POES program, a MetOp Ground Systems Working Group has be formed with personnel representing all appropriate NESDIS and NOAA organizational elements. The charter for the working group is to identify, prioritize, and provide program information necessary to define the ground segment support from NOAA and EUMETSAT to implement the IJPS Agreement. The MetOp Coordinator is the chairperson of the working group.

The roles and responsibilities of NESDIS organizational elements and their support to the working group are described in the following paragraphs.

Ground Systems Division

- Resident source of expertise in ground systems design
- Generates plans to support new satellite systems, ground segment upgrades, and the introduction of new services and products
- Evaluates new technologies for satisfying current and future ground segment requirements
- Leads ground segment acquisition activities
- Leads verification and validation activities.

Radio Frequency Manager

- Coordinates radio frequency requirements for all programs within DOC
- Reviews and coordinates frequencies planned for use on the POES and MetOp satellites
- Reviews and coordinates the sharing of meteorological frequencies with other agencies.

Office of Satellite Operations

- Operates POES satellites on a 24 hour per day, seven day per week basis
- Develops and maintains operations concepts
- Leads activities for preparation of JORP
- Monitors acquisition projects for integration into ground segment elements operated by Office of Satellite Operations (OSO)
- Supports and participates in verification and validation activities.

Office of Satellite Data Processing and Distribution

- Processes POES satellite observations on a near real-time, 24 hour per day, seven day per week basis, into a wide variety of products and services
- Performs instrument calibration, satellite navigation and data earth location functions for all raw POES satellite orbital data streams
- Generates geophysical products from calibrated and earth located radiance measurements
- Performs quality control and monitoring of all operational systems and products
- Distributes operational products to domestic and international users
- Provides for real time access to operational instrument data sets and products
- Coordinates with ORA for implementation of upgraded algorithms for generation of improved products
- Coordinates with ORA and OSD for implementation of new product systems
- Coordinates activities to insure system readiness ro new launches
- Provides input to the OSD/Polar Products Manager in planning, developing and budgeting for new systems
- For MetOp, lead responsibility for acquisition and development of the Front-End Processor for ingesting and pre-processing the MetOp data stream
- For MetOp, lead responsibility for Reviews, and coordinates on acquisition requirements for updating the PDPS and the processing environments for polar generated data sets and products as defined in the NESDIS Guide to Satellite Products and Services Implementation [Reference 3].
- Leads the acquisition activities to upgrade the PDPS to support the continued generation of Polar Level 1 data sets from the common instruments on the MetOp morning satellite
- For MetOp, interfaces with EPS Satellite Applications Facility (SAF) for Level 1 processing code if required.

Office of Research and Applications

- responsible for scientific quality assurance of operational polar instrument data sets and products
- Responsible for research and development activities resulting in improved and new mathematical algorithms for operational products
- Assists OSD and OSDPD in developing and/or modifying the operational processing systems supporting developed algorithms for new and/or improved polar products
- Provides input to the OSD/Polar Products Manager in planning, budgeting and developing prototype systems to incorporate the mathematical algorithms associated with processing MetOp mid-morning satellite data as the NOAA morning satellite
- For MetOp, coordinates with OSDPD on the development of Level 1 processing of the MetOp data stream and leads the validation activities of all Level 1 data sets for the MetOp satellite
- For MetOp, leads the activities for validation of products from NOAA's instruments on the MetOp satellite

- For MetOp, development of additional products from MetOp satellite data sets for morning orbits as required by users
- Interfacing, if required, with MetOp SAF products, implementation of EUMETSAT software at CEMSCS, or new math algorithms for MetOp instruments

National Climatic Data Center

- Updates the archive process by copying data sets from CEMSCS disk storage to magnetic tape and maintains the Satellite Archive and Retrieval System (SARS) archive inventory catalog
- Responsible for the permanent off-site archive for the POES system
- Prepares and implements plans for product data formats, access, dissemination and archiving which includes archival software procedures and end user documentation.

In addition to the support of NESDIS organizational elements, the MetOp Ground Systems Working group also has representation from the Systems Acquisition Office (SAO), users and contractors supporting the POES program to assist in reviewing and implementing ground segment activities.

4.1.2 Project Structure

In the life cycle of acquisition programs, the traditional acquisition model include the following phases:

- Phase O: Concept Exploration
- Phase I: Program Definition and Risk Reduction
- Phase II: Engineering and Manufacturing Development
- Phase III: Production, Deployment, and Operational Support.

The planned upgrades to the POES Ground Segment to support NOAA's responsibilities as described in Section 2.3 are Engineering Developmental Phase activities. This phase comprises several incremental acquisition activities to provide new capabilities for the overall ground segment. The planned activities are the product of over a decade of concept definition activities between NOAA and EUMETSAT and the output of contractor studies where performance and cost issues were analyzed.

4.1.3 Task Authorization Process

Implementation of the changes to the POES Ground Segment to support MetOp-1 and MetOp-2 satellites and to exchange global satellite data with the EPS will be accomplished over a five year time period. This will require the continued support for multi-year projects in the NESDIS budget and the timely implementation of acquisition projects through contractual actions. Therefore, task authorizations will be implemented for projects on two levels. They are the program budget level, and at the individual department/contract level.

The budget for implementing the approved POES program is an integral part of the Federal Budget submitted annually for Government supported programs. In support of this process, the POES Program Manager prepares and presents program and budget information for Polar programs that identifies those projects that must be implemented to maintain continuity in satellite coverage from space in support NOAA's mission. Inputs are provided to this process from all organizational elements supporting Polar programs. Inputs to current budgets for the IJPS were derived from funded studies by contractors and analyses done by NESDIS engineers, scientists and managers to define the technical and cost impacts on the POES Ground Segment.

Through this process, funding levels have been established for implementing projects in support of the IJPS agreement. Starting in Fiscal Year (FY) 2000, planning budgets have been established in the NESDIS budget to support the IJPS Agreement as described in Section 4.6 of this plan. The POES Program Manager will continue to support and defend the Polar budget for each fiscal year. The program manager will review, allocate, and authorize the use of all budgeted dollars for approved Polar projects. Because funding levels change during the fiscal year, this process continues throughout the year.

Based on approved program budgets, organizational elements are authorized to take appropriate action in implementing their projects as reflected in this plan. The largest group of projects are assigned to the GSD of OSD for implementation. The responsibility for implementing projects within the GSD is assigned to a Contracting Officer's Technical Representative (COTR). The COTR, working with the designated Contracting Officer, is responsible for reviewing and authorizing all work on assigned contracts.

In a similar manner, projects assigned to OSDPD that result in acquisition contracts will also use COTRs for authorizing and administering assigned work. Work may be assigned to the Office of Satellite Dat Processing and Distribution (OSDPD) support contractor, in place at that time, with the assigned COTR authorizing and administering all assigned tasks. In addition, some projects to be implemented by OSDPD and ORA will be conducted by government engineers and scientists. For these projects, the responsible manager will authorize and administer the projects to be implemented.

The POES Program Manager will be fully informed on the status of acquisition projects through program reviews and meetings as described in this plan.

4.1.4 Revised Ground Segment Interface Baseline

During the time period for IJPS operations, the initial ground segment interface baseline for the POES Ground Segment with the EPS will be as defined in the programmatic, operational and technical documents that comprise the Configured Baseline Documentation Set (CBDS) included in the PIP. The CBDS will represent the coordinated baseline between NOAA and EUMETSAT for the IJPS. With the signing of the PIP by both NOAA and EUMETSAT, the CBDS will be placed under formal configuration control by both parties. All changes to documents listed in the CBDS will then be jointly signed by the program managers for both parties.

To reach the coordinated baseline for the IJPS era, configuration baselines will be established through the configuration management procedures described in the POES Program Plan [Reference 8] and the joint configuration management procedures defined in the PIP. Following these procedures, incremental baselines will address the evolutionary changes occurring in the current POES baseline (e.g.. changes to reflect the planned configurations upgrades to the CDAs to install new transmit/receive antennas for future satellites, for NOAA-N and -N' and for the planned upgrades to the POES Ground Segment) to implement the IJPS.

In support of the POES Program Manager, the MetOp Coordinator will be the point of contact for implementing the joint configuration management procedures with EUMETSAT. The MetOp Coordinator will document the receipt of all inquiries and proposed changes to the requirements contained in the CBDS, including the PIP. The MetOp Coordinator will make all appropriate distributions within NESDIS, the SAO and NASA; submit formal changes related to the IJPS to the NESDIS Configuration Control Board for evaluation and approval, monitor actions taken as part of the formal configuration control process, coordinate the signature of all appropriate program managers, and distribute directive documentation on each change. The MetOp Coordinator will also be responsible for ensuring that both NOAA and EUMETSAT are provided the latest changes to "Referenced Documents," listed in the PIP, as they occur.

4.2 Reviews

Design reviews are an integral and essential part of the NESDIS program management and systems engineering process. Each acquisition will have a tailored list of formal technical reviews associated with its development activities. These reviews will be listed in the acquisition documentation approved by the POES Program Manager. The POES Program Manager will invite members of EUMETSAT and ESA to attend program reviews as defined in the PIP to address topics of interest that may impact the EPS. Similarly, the POES Program Manager, and members of the ground segment project team will attend EPS reviews to address topics relates to NOAA's support for MetOp satellites and the exchange of global and telemetry data between the two satellite systems.

Ground segment acquisition activities will be structured and managed on two levels. They are the project level and the individual acquisition activity level. The overall MetOp Ground Systems Working Group will be structured to review and monitor the end-to-end performance of the ground segment and its interfaces with the EPS ground and satellite segments. At the project level, the Ground Segment Working Group will conduct formal reviews for assessing the progress of the assigned tasks and the readiness of the work to be continued. Reviews planned for ground segment acquisition tasks at the formal project level, are as follows:

- System Functional Review Ground segment functions will be reviewed and allocated to the appropriate ground segment element(s) that are impacted by changes.
- System Requirements Review Ground segment performance requirements will be reviewed and allocated to the appropriate ground segment element(s) that are impacted by changes.

- Test Readiness Review/MetOp Compatibility Review Review(s) assure adequate test plans, resources, and schedules exist to conduct planned tests.
- System Readiness Review Establish the readiness of the ground segment to support planned operations

Individual acquisition activities will be managed using a series of reviews tailored to reflect the technical content of the work to be performed and the potential application of commercial off-the-shelf (COTS)/Non-Developmental Items (NDI) to accomplish the IJPS mission. These reviews are planned to be accomplished separately due to the time phasing of the acquisitions in the project budget and the time it takes to complete the activity. At the activity level, reviews planned for ground segment acquisition tasks are as follows:

- Preliminary Design Reviews Assess compliance of proposed design with requirements
- Critical Design Reviews Confirm the design details and performance to be achieved

The proposed acquisition projects fall into two basic groupings. The first group are those activities required to upgrade the ground segment to support MetOp satellites and provide the capability to produce NOAA Day-1 products. OSD, with the active support of OSDPD, has the lead responsibility for implementing these activities and conducting associated reviews. The second group provides current and enhanced environmental products from the data sets available from MetOp satellites. OSDPD has the lead responsibility for implementing these activities and for conducting associated reviews as described in the NESDIS guide for implementing satellite products and services as tailored for each acquisition [Reference 3].

4.3 Meetings

Meetings will be held at the program, project and individual contract/task level as required to disseminate information on planned ground segment upgrades and changes to all parties that will interface with or support these activities. Meeting agendas will be the responsibility of the organization/ individual calling the meeting, as well as the preparation of minutes to be signed by the responsible person for all organizational elements in attendance. The POES Program Manager and his staff will be on the distribution lists for all meeting minutes.

4.3.1 Program Coordination Meetings

Program coordination meetings will be held at least on a semi-annual basis between NOAA and EUMETSAT to coordinate and exchange information on their respective programs and commitments to the IJPS Agreement. These meetings will be arranged to take place alternately between NOAA and EUMETSAT sites. The POES Program Manager and project team members as required will attend these meetings to support assigned agenda items.

Program level Technical Information Meetings (TIMs) will be conducted quarterly, or sooner if required, to coordinate technical details, provide status and to resolve problem areas that will assist design team in completing their tasks. However, the identification of new requirements, or technical problems that will affect the technical performance, schedule or cost of the IJPS will be brought to the attention of the respective program managers for resolution.

4.3.2 Project Meetings Coordination

Information on scheduled project meeting plans will be shared by the POES and EPS teams and updated regularly. Meeting agenda and proposed participant lists, as required to support agenda items, will be provided to both parties at least one week in advance wherever possible to support final planning for associated travel.

The MetOp Coordinator will be the point of contact for establishing regularly scheduled meetings by the POES team and for publishing and distributing agenda and participants lists for these meetings to both the POES and EPS points of contact. The MetOp Coordinator will also be the point of contact for receiving similar schedules for the EPS team and distributing the information to the POES team. The MetOp Coordinator will be on the distribution list for meeting minutes from all scheduled meetings for both parties. As part of the meeting minutes, action items assigned at the scheduled meetings will be listed.

The MetOp Coordinator will track the action items assigned to the POES team and periodically, at least monthly, report on the status of the actions being taken. The MetOp Coordinator will receive and distribute, to the POES team, the EPS status reports of their assigned action items.

The MetOp Coordinator will be assisted in performing these functions by the Polar Products Manager and an SAO point of contact. The Polar Products Manager will collect and provide information on scheduled meetings within OSDPD on the development of products to support the IJPS Agreement. Similarly, the SAO point of contact will collect and provide information on the development of common instruments, assembly and integration of the spacecraft and instruments, and launch and early orbital support as defined and managed by NASA. Information from these two sources will be integrated by the MetOp Coordinator in to an overall program schedule.

4.3.3 Project Meetings

Meetings will be established at all levels to assist and facilitate the implementation of approved tasks for the POES Ground Segment. The responsible person establishing each individual meeting will prepare agenda and proposed attendance lists. This information will be published to members of the MetOp Groung Systems Working Group and the MetOp Coordinator. Maximum use will be made of standard distribution lists, e-mail lists, and web site pages to ensure that proper personnel are in attendance at meetings.

4.4 Documentation and Deliverables

The MetOp Coordinator, with inputs from the SAO, the GSD of OSD, OSDPD and ORA, will establish and monitor lists of all documentation and deliverables to be exchanged between NOAA and EUMETSAT that are associated with the design, development, testing and validation of their respective ground segments. This will include, but not limited to:

- Space to Ground and Ground to Ground interface engineering
- The development of the scientific data (pre-) processing

Initial lists of program documentation and deliverables for NOAA and EUMETSAT are included in the PIP, reflecting the results of implementation planning to date. With the signing of the PIP, the CBDS will be placed under configuration control as discussed in Section 4.1.4. Similarly, the Referenced Document List will be maintained current by both parties. The MetOp Coordinator will initiate monitoring of the status of documentation and deliverables to be exchanged between NOAA and EUMETSAT based on these lists.

To support the ground segment operations functionality identified in Section 2 of this plan, additional capabilities will be incorporated into the current POES Ground Segment to support satellite operations with MetOp-1 and MetOp-2. To provide these capabilities, NOAA will implement the development and acquisition tasks listed in Section 3. As part of the systems engineering activities required to implement these tasks, the preparation of technical documentation and the delivery of equipment and services will be included as required to support efforts to establish new ground segment baselines, establish clear interfaces with the EPS, support verification and validation level testing, and provide information for the Test Readiness Review and the System Readiness Review. The general items of documentation to be provided as part of these activities include the following:

<u>General Documentation for Acquisitions including COTS/NDI</u>
(Specific items to be selected from Joint Industrial Standard 16)

- Specifications
- Drawings
- Manuals
- Training Materials
- Test Plans
- Test Procedures
- Reports

<u>NESDIS Developed Software Algorithms</u> [References 3 and 4]
(Items to be selected from NESDIS Guide to Satellite Products and Services)

- Program Description Document
- Systems Description Document
- Maintenance Manual
- Operational Events Log
- Interface Control Document

- User's Manual
- Operations Manual

The MetOp Coordinator will review and coordinate on all development and acquisition tasks prior to their being formally started to ensure that complete data item lists are prepared and included as part of the planned tasks. Those items that impact the IJPS Agreement, will be added to the documentation lists monitored by the MetOp Coordinator for their planned and actual delivery dates. The MetOp Coordinator will review the status of planned documentation with the POES Program Manager during monthly program reviews. The MetOp Coordinator will be assisted in this task by the Polar Products Manager and the POES Systems Engineer to ensure that the IJPS Agreement is being supported.

4.5 Project Schedule

Project schedules will be based on the launch schedules for NOAA-N and -N' and for MetOp-1 and MetOp-2 as shown in Section 1.4 of this plan. Based on these dates the overall schedule for NOAA's support for the IJPS is shown in Figure 4.

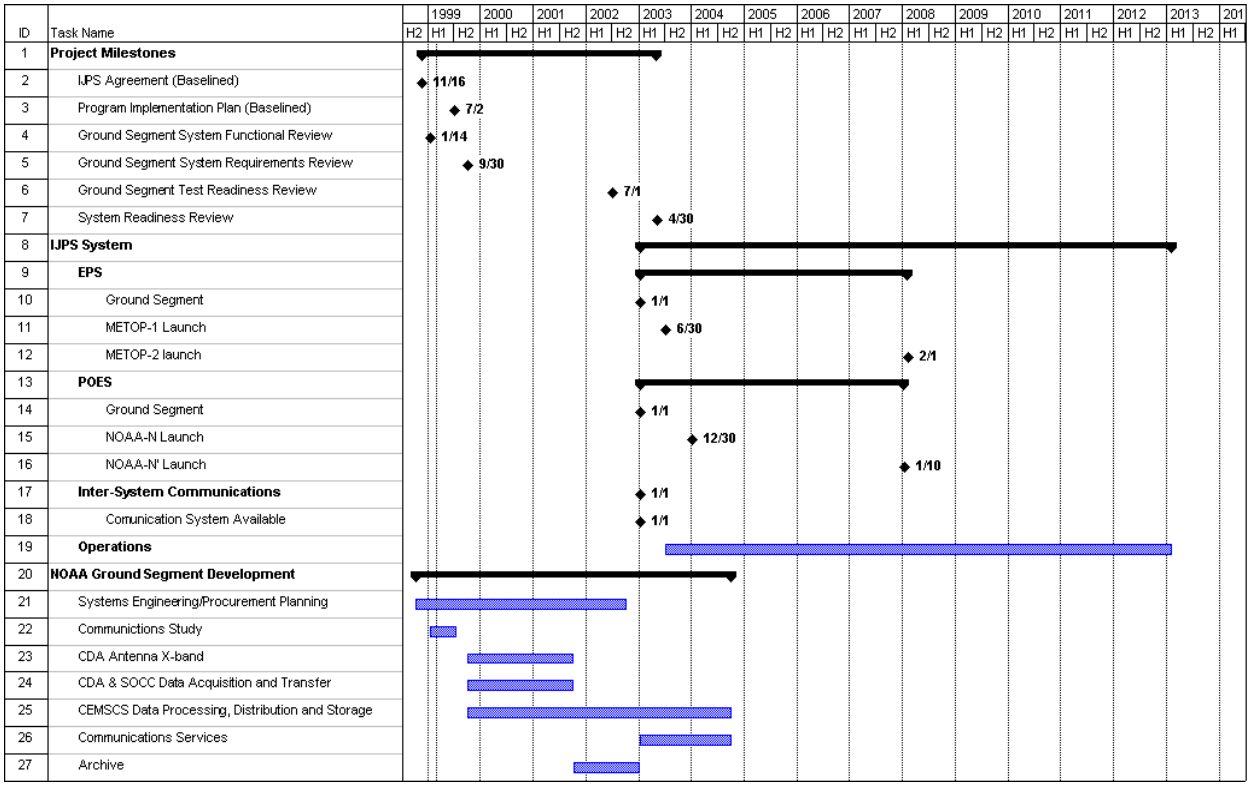

Figure 4 NOAA Ground Segment Schedule for Support of IJPS

In support of the POES Program Manager, the MetOp Coordinator will prepare and maintain working schedules for all planned activities by NOAA to upgrade the ground segment in preparation of supporting MetOp satellite operations. The activities will be scheduled for completion to allow the ground segment to support integration and end-to-end testing starting six months prior to the launch of MetOp-1. An initial working schedule for ground segment activities is included in Appendix B.

The MetOp Coordinator will prepare quarterly updates to the NOAA project working schedules for ground segment activities. The SAO will provide similar schedules for NASA supported activities for instruments, spacecrafts, and space segment integration activities. These schedules will be used by the POES Program Manager for exchanging schedule information between the NOAA and EUMETSAT program managers.

4.6 Project Cost

The project cost for updating the POES Ground Segment to support the IJPS Agreement is reflected in the following chart. The cost information was developed based on estimates prepared from results of a NASA conducted study titled "POES 2003 Baseline Ground System," completed in the Spring of 1998. In addition, inputs from Government personnel supporting the ground segment were used to validate the cost estimates and their time-phasing on the program. The cost presented represents the total cost to complete in that the proposed changes must be implemented and validated to support IJPS operations starting 2004. All future costs will be included in the operational (Non-Capital, Recurring) portion of NOAA's budget for their continued operation.

The proposed upgrades to the POES Ground Segment will be implemented in a series of individual acquisition projects as described in Section 3. This allows for the time phasing of the work over allowable budget years, while meeting developmental and operational needs.

5. Test and Evaluation

Test and Evaluation activities are an integral part of acquisition programs to provide verification and validation that the desired performance capability has been provided. Tests will be conducted to assure that new or modified segment elements are thoroughly tested and characterized prior to their incorporation into the operational system.

In this manner, planned upgrades to the POES Ground Segment will be tested at the unit/acceptance, interface and integration level prior to their use in supporting system level testing. Unit/acceptance tests will be the responsibility of the contractor/agency providing the upgrade. Interface and system level tests for the ground segment will be planned and implemented by the OSD GSD with the support of designated support contractors. Launch readiness tests will be planned and implemented by the agency responsible for the satellite launch readiness activities. For the NOAA-N and -N' satellites, the NOAA/NASA team will be responsible for planning and implementing all launch readiness activities. For the EPS MetOp-1 and MetOp-2 satellites, the EUMETSAT/ESA/CNES team will be responsible for these activities.

5.1 Unit/Acceptance Tests

For the acquisition tasks identified in Section 3 of this plan, OSD GSD will ensure appropriate requirements for performance and testing are established for each acquisition activity. Documentation to include specifications, test plans, test procedures and test reports will be provided where appropriate as part of the acquisition task. Unit tests are planned and implemented as part of the acquisition task to verify performance capabilities at the box/module level of assembly. These tests are only monitored by the government on a sampling/exception bases prior to integration into a higher level of assembly. Acceptance tests are conducted at the contractor's site and/ or designated government site to verify that the delivered item provides the specified performance. OSD GSD will be responsible for reviewing and approving test plans and procedures and will lead the NESDIS test team designated to witness these tests.

5.2 Interface Tests

Interface tests will be planned and implemented to validate items delivered and installed into the ground segment continue perform as specified at all interfaces within the segment. OSD GSD will ensure requirements for performance and testing are established and included in the acquisition process similar to that included for unit testing in Section 5.1 OSD GSD will be responsible for reviewing and approving test plans and procedures for these tests and will lead the NESDIS test team designated to witness these tests.

5.3 Integration Tests

Integration tests will be planned and implemented for ground segment elements to validate that items delivered and installed perform correctly. Integration tests will be conducted with real source data from the actual satellite to be supported (e.g. MetOp, POES). OSD GSD will be responsible for reviewing and approving test plans and procedures for these tests and will lead the NESDIS test team designated to witness these tests. NESDIS OSO operations personnel will support these tests.

5.4 Launch Readiness Tests

Launch readiness tests include those activities that are planned and implemented to characterize and verify all interfaces between the POES and EPS satellite systems prior to the launch of individual satellites. These tests can include compatibility tests and end-to-end tests to verify that all required elements are ready to support launch and early orbit and satellite operations. Certification and system simulation activities may also be scheduled to validate the readiness of the operational personnel to support planned operations.

Planning and conducting launch readiness tests will be the responsibility of the NOAA/NASA or EUMETSAT/ESA/CNES test teams to ensure that all preparations for their respective satellites are completed satisfactorily. NESDIS OSO operations personnel will support these tests as coordinated and in accordance with approved schedules. NESDIS OSD GSD will be responsible to review the tests and coordinate any changes required as the results of these tests.

6. Risk Management

This section identifies the potential risks associated with the acquisition and operation of the NOAA-EUMETSAT IJPS and summarizes the planned risk mitigation activities. The risk in this program is not unique; every program is subject to uncertainties that could result in a failure to achieve mission, programmatic, or performance objectives. To achieve program performance objectives within defined cost and schedule limits using approved acquisition strategies and maintenance and operational procedures, risk must be managed.

Risk Management consists of identifying what adverse events may occur, the likelihood of each event occurring, and the impact of the event on the program. Given this data, the manager can then mitigate the risk by decreasing the probability of the event occurring; developing a plan to deal with the effects of the event such that damage to the program is minimized; or accepting the risk as reasonable.

The following list of risk areas have been identified for the initial joint program:

- Mission
- Management
- Acquisition
- Operations

Identified risks have been grouped into these risk areas, and planned risk mitigation plans are described. As the program progresses through the life cycle, new risks will be identified and mitigation techniques applied.

6.1 Mission Risk

For the POES Ground Segment as an element of the IJPS, the following mission risk areas have been identified:

- Continuity of satellite data: The introduction of new hardware and software into the ground segment to receive, process, transport, and store mission data could introduce discontinuities in mission data due to late or non-operable ground segment elements, or changes in mission data delivered to users
- Reliability and availability: With the increase in number of elements in the ground segment to satisfy mission requirements, system reliability and availability parameters could be impacted
- Launch environment induced satellite loads: Design of current NOAA's instruments to be carried on MetOp satellite could be damaged if launched on Ariane 5 launch vehicle
- Data denial policy: Implementation of data denial policy prior to the launch of IJPS satellites could impact program milestones.

To mitigate mission risks associated with the POES Ground Segment upgrade activities, this project plan reflects the action being taken by the POES program manager in establishing clear technical and programmatic interfaces with EUMETSAT and ensuring that the full impact of changes on the POES system are evaluated. The IJPS Agreement and the PIP [References 1 and 7] document all joint technical and programmatic requirements between NOAA and EUMETSAT. Although the PIP will not be finalized until mid-1999, much work has been accomplished between the two parties to define clear statements of requirements to be supported by the ground segments. NOAA has completed a ground system study to analyze technical , schedule and cost impacts on the current POES Ground System to support the IJPS [Reference 2]. NOAA will continue to review all allocated requirements during FY 99 at planned system functional and system requirement reviews in support of preparing final procurement packages for acquiring upgrades to the POES Ground Segment starting in FY 2000. NOAA will continue to assess system parameters at project and joint reviews to assure that POES and IJPS requirements are satisfied by all upgrades. Working groups are in place to address known issues/problems dealing with data denial policy and the satellite loading induced by the Ariane 5 launch vehicle.

Planning for mission data processing from the common instruments and the additional instruments of opportunity carried on the POES and EPS satellites will be characterized by the exchange of technical documentation and joint coordination and visibility into development activities. Mission data processing from the common instruments will strive to output similar products as provided by the NOAA morning satellite operating in the 2003 era. Although the POES and EPS satellites implement different data handling systems and data formats, retrieval of the mission data will output like data sets. This approach will provide continuity with the data being processed and archived by NOAA, at that time. Additionally, mission data processing from the instruments of opportunity by NOAA is planned to support NOAA user requirements in the 2003 era. These data sets may define new archival requirements for NOAA.

6.2 Management Risk

For the POES Ground Segment as an element of the IJPS, the following management risk areas have been identified:

- Approved requirements baseline [Reference 7, para 3.1]: Introduction of new requirements, or modifications to existing requirements, during or after the design/development process has commenced could cause delays due to the need to obtain new budget support and approval, and/or schedule delays in meeting program milestones
- Joint program responsibilities [Reference 7, para 3.1]: Implementing joint coordination and visibility requirements for technical interfaces and program milestones could delay timely programmatic actions
- Project budget [Reference 7, para 3.1]: The multi-year budget for the IJPS program could be changed or delayed during each fiscal year budget process
- Schedule [Reference 7, para 3.1]: Meeting mission requirements depends on NOAA and EUMETSAT jointly meeting schedule milestones

- Joint collaboration on software development for mission data processing: The timely exchange of technical documentation, changes in processing environments, availability of ancillary data and files, and availability of test data sets all could impact product processing capabilities to support program milestones
- Joint configuration control [Reference 7, para 3.1]: Timely approval of changes to interface specifications could impact schedules and delay required performance.

To mitigate the management risks associated with the POES Ground Segment activities, this project plan reflects the actions being taken by the POES Program Manager in establishing clear technical and programmatic interfaces with EUMETSAT and ensuring project and joint responsibilities are supported. As discussed in Section 6.2 above, efforts are under way to ensure that a sound technical baseline is established prior to starting acquisition projects funded in the FY 2000 budget. Within NOAA, the Assistant Administrator for Satellite and Information Services established support for the IJPS program as a high priority project within the agency's budget request. Should changes in requirements occur in the future, minor adjustments can be made in the planning years of the multi-year project budget. However, lead times for budget requests, acquisition support, and contract implementation could impact project milestones for joint support.

At the direction of the POES Program Manager and in support of the PIP, the Ground Segment Project Plan was prepared to document how the POES program is being managed as an independent program while supporting IJPS requirements. The plan identifies responsibilities for coordinating and changing requirements, establishing schedules and milestones, and exchanging data for the development of product processing capabilities. An Implementation Plan will also be prepared to reflect how all responsibilities are being supported. Preparation and coordination of these plans will mitigate management risks by ensuring proper coordination, review and verification activities are being planned and implemented.

6.3 Acquisition Risk

Acquisition risks are linked with the timely upgrades required in ground segment elements to support allocated IJPS requirements. These activities are associated with the following risks:

- Approved requirements baseline: Preparation of procurement packages could be impacted if all requirement are not known
- Acquisition Strategy: Changes in requirements and schedules could cause associated changes in the acquisition strategy
- Multi-year funding: Changes in out-year planned budgets could impact work milestones and schedules
- Schedule: Changes in acquisition activities scheduled to provide new capabilities could impact mission support milestones
- Test and Evaluation: Testing of new capabilities for acceptance and during integration activities with ground segment elements could identify new problems

- Training: Acquisition on new capabilities may require updates in training provided for the operations personnel.

To mitigate the acquisition risks associated with the POES Ground Segment activities, this project plan reflects the actions being taken by the POES Program Manager in establishing clear technical and programmatic interfaces with EUMETSAT and ensuring project and joint responsibilities are supported. Requirements are being jointly planned and baselines established by NOAA and EUMETSAT prior to finalizing all procurement packages for acquiring upgrades to the POES Ground Segment funded in FY 2000. Priorities have been established for the multi-year budget planned to support the acquisition strategy and planned launch schedules have been coordinated and established with EUMETSAT that will ensure continuity of mission data for NOAA. Adequate training and documentation on changes to the ground segment will be provided as part of the planned acquisitions.

6.4 Operations Risks

For the POES Ground Segment as an element of the IJPS, operational risk areas have been identified as the results of incorporating new capabilities into the ground segment and identifying new operational procedures to be supported. Generally, risk is associated with the fact that introducing change into current POES operations needs to be timely and appropriate in the following areas:

- SOCC and CDA backup operations: Current SOCC and CDA backup operations will need to be updated and verified for IJPS operations
- Integrate EUMETSAT instrument procedures: Changes for the MHS instrument on the POES satellite will be updated by NASA as part of its launch readiness activities
- Communications:
- Provide EPS cross-support operations: Command and telemetry access during blind orbit operations will require new administrative coordination, scheduling and operations procedures
- Make available satellite housekeeping data: New operations procedures will be prepared to access satellite telemetry data archived at the CDA and delivered to EUMETSAT
- Make available all global data: New operations procedures will be prepared to access satellite global data archived at the CDA and delivered to EUMETSAT
- Assist in satellite anomaly or emergency situations: New administrative and operations procedures will be prepared to coordinate and implement special requests for ground segment support
- Joint operations training: For new capabilities added to the ground segment, adequate training is required for operations personnel.

To mitigate operations risks associated with the POES Ground Segment upgrade activities, this project plan reflects the actions being taken by the POES Program Manager in the early identification of operations requirements, identifying changes for their implementation and testing, and providing technical documentation and training support to operational personnel in developing and updating

operational procedures. NOAA is preparing the JORP document, in coordination with EUMETSAT, to identify the operations that will be supported by the POES and EPS systems. Satellite data (recorded and/or live) will be made available to validate ground segment changes and new and updated procedures prior to starting satellite operations. Launch readiness tests validating the joint activities between the POES and EPS systems are also planned.

Glossary

1. The following definitions for “Data Levels” are used in the discussions related to processing satellite data from NOAA satellites into products for users.

   Level 0 - Raw data in its original format as received from the satellite.

   Level 1a - Reconstructed, unprocessed instrument data at full space-time resolution with all available supplemental information to be used in subsequent processing (e.g. health and safety) appended.

   Level 1b - Unpacked reformatted level 1a data at full space-time resolution with pixel localization and calibration coefficient computed. Navigation information relative to earth view are computed. All are appended along with all auxiliary and ancillary data required to compute them (e.g. calibration target counts, orbit parameters).

   Level 1c - Not yet defined. (To address IASI apodized data)

   Level 2 - Retrieved environmental variables at the same resolution and location as Level 1 source data.

2. The following definitions for “Data Levels” are used in the discussions related to processing satellite data from MetOp satellites into products for users.

   Raw Data - Data in their original packets, as received from the satellite.

   Level 0 (data flow) - Reconstructed, unprocessed instrument data at full space-time resolution with all available supplemental information to be used in subsequent processing (e.g. ephemerids, health and safety) appended.

   Level 1a - Unpacked, reformatted Level 0 data at full space-time resolution with all supplemental information to be used in subsequent processing appended.

   Level 1b - Radiometrically corrected and calibrated data in physical units at full instrument resolution as acquired.

   Level 1c - Not yet defined. (To address IASI apodized data and ATOVS sounding and/or imager data remapped on a common instrument grid)

   Level 2 - Retrieved environmental variables at the same resolution and location as Level 1 source data.

Acronym List

AMSU	Advanced Microwave Sounding Unit
AOR	Areas of Responsibilities
APT	Advanced Picture Transmission
ARGOS	
ASCAT	Advanced Scatterometer
AVHRR	Advanced Very High Resolution Radiometer
BPSK	Binary Phase Shift Keying
CBDS	Configured Baseline Documentation Set
CCSDS	Consultative Committee for Space Data Systems
CDA	Command and Data Acquisition
CDR	Critical Design Review
CEMSCS	Central Environmental Satellite Computer System
COTR	Contracting Officer's Technical Representative
COTS	Commercial off-the Shelf
DCS	Data Collection System
DOC	Department of Commerce
DOD	Department of Defense
EPS	EUMETSAT Polar System
ESA	European Space Agency
ESSA	Environmental Science Services Administration, precursor to NOAA
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
FCDA	Fairbanks Command and Data Acquisition Station, NESDIS, Fairbanks, AK
FEP	Front End Processor
FY	Fiscal Year
GAC	Global Area Coverage
GOES	Geostationary Operational Environmental Satellite
GOME	Global Ozone Monitoring Experiment
GRAS	Global Navigation Satellite System Receiver for Atmospheric Sounding
GSD	Ground Systems Division
GSFC	Goddard Space Flight Center
GSTDN	Goddard Satellite Tracking and Data Network
GTS	Global Telecommunications Service

HIRS	High Resolution Infrared Radiation Sounder
HRPT	High Resolution Picture Transmission
IASA	Infrared Atmospheric Sounding Interferometer
IF	Intermediate Frequency
IJPS	Initial Joint Polar System
IRD	Interface Requirement Document
IRV	Inter-Range Vectors
JORP	Joint Operations Rules and Procedures
JPS	Joint Polar System
kbs	Kilobits per second
LAC	Local Area Coverage
LNA	Low Noise Amplifier
MCR	MetOp Compatibility Review
MetOp	Meteorological Operational (satellites), EUMETSAT
MFR	Multi-Function Receiver
MHS	Microwave Humidity Sounder
NASA	National Aeronautics and Space Administration
NCDC	National Climatic Data Center, NESDIS
NDI	Non-Developmental Items
NESDIS	National Environmental Satellite, Data, and Information Service, NOAA
NOAA	National Oceanic and Atmospheric Administration, DOC
NPOESS	National Polar-orbiting Environmental Satellite System
NSC	NOAA Science Center, formerly the World Weather Building
NWS	National Weather Service
ORA	Office of Research and Applications, NESDIS
OSD	Office of Systems Development, NESDIS
OSDPD	Office of Satellite Data Processing and Distribution, NESDIS
OSO	Office of Satellite Operations, NESDIS
PACS	Polar Acquisition and Control System
PDPS	Polar Data Processing System
PDR	Preliminary Design Review
PG&D	Product Generation and Distribution
PIES	Post Installation Engineering Support
PIP	Program Implementation Plan
POES	Polar-orbiting Operational Environmental Satellites

QPSK	Quadrature Phase Shift Keying
RF	Radio frequency
SAA	Satellite Active Archive
SAF	Satellite Applications Facility
SAO	Systems Acquisition Office
SARS	Satellite Archive and Retrieval System
SARSAT	Search and Rescue Satellite Aided Tracking
SATCOM	Satellite Communications
SCT	Stored Command Table
SEM	Space Environment Monitor
SFR	System Functional Review
SOCC	Satellite Operations Control Center, NESDIS, Suitland, MD
SOMS	Satellite Operations Management Subsystem
SPP	Shared Processing Program
SRR	System Requirements Review
SRR	System Readiness Review
TDPS	Tracking Data Processor Subsystem, POES
T&C	Telemetry and Command
TIP	TIROS Information Processor
TIM	Technical Information Meeting
TIROS	Television Infrared Observation Satellite
TRR	Test Readiness Review
USGS	US Geological Survey, DOI
VCDU	Virtual Channel Data Unit
VHF	Very High Frequency
WCDA	Wallops Command and Data Acquisition Station, NESDIS, Wallops, VA
WMO	World Meteorological Organization

Appendices

A. Requirements Matrix

B. Project Schedules

Appendix A

Requirements Matrix

NOAA GROUND SEGMENT LEVEL 1 REQUIREMENTS ALLOCATION								
		NOAA Ground Segment Elements						
Item Num.	Operational Requirement	Source	Command and Data Acquisition	Satellite Operations Command and Control	Data Processing and Distribution	Communications	Archive	Other
1-1	Each party shall (1) control its own satellite, including the instruments they carry, regardless of their origin.	PIP Para. 2.6.1.1	X	X		X		
1-2	Cross-support for satellite operations: NOAA shall (2) provide commanding access and housekeeping telemetry acquisition to/from the EUMETSAT satellite for those orbits which are not visible from the EUMETSAT Polar Command and Data Acquisition (PCDA) station, located in Northern Europe and on request for specific operations (e.g. launch and early orbits, contingency...).	PIP Para. 2.6.1.2	X	X		X		

NOAA GROUND SEGMENT LEVEL 1 REQUIREMENTS ALLOCATION

		NOAA Ground Segment Elements						
Item Num.	Operational Requirement	Source	Command and Data Acquisition	Satellite Operations Command and Control	Data Processing and Distribution	Communications	Archive	Other
1-3	Cross-support for satellite operations: EUMETSAT shall (3) provide commanding access and housekeeping telemetry acquisition to/from the NOAA satellite for those orbits which are not visible from the NOAA Command and Data Acquisition (CDA) station, located in Fairbanks and Wallops, and on request for specific operations (e.g. launch and early orbits, contingency...).	PIP Para. 2.6.1.2	X	X		X		X
1-4	For cross-support the ground segments shall (4) operate in a throughput mode (bent-pipe), i.e. without processing of the commands or the telemetry other than that related to the Ground-to-Ground transmission.	PIP Para. 2.6.1.2	X	X		X		
1-5	The NOAA Ground Segment shall (5) be sized to provide blind orbit cross-support to one operational EUMETSAT satellite; additional requests will be accommodated within that sizing.	PIP Para. 2.6.1.2	X	X		X		

NOAA GROUND SEGMENT LEVEL 1 REQUIREMENTS ALLOCATION

		NOAA Ground Segment Elements						
Item Num.	Operational Requirement	Source	Command and Data Acquisition	Satellite Operations Command and Control	Data Processing and Distribution	Communications	Archive	Other
1-6	The EUMETSAT Ground Segment shall (6a) be sized to provide blind orbit cross-support to one operational NOAA satellite; all reasonable efforts shall (6b) be made to accommodate additional requests within that sizing.	PIP Para. 2.6.1.2	X	X		X		
1-7	NOAA and EUMETSAT shall (7) archive all Housekeeping Data received from their respective satellite.	PIP Para. 2.6.1.3	X	X		X	X	
1-8	NOAA shall (8) make available to EUMETSAT, on a agreed upon basis, the Housekeeping Data of MHS received from the NOAA Satellites.	PIP Para. 2.6.1.3	X	X		X		
1-9	EUMETSAT shall (9) make available to NOAA, on a agreed upon basis, the Housekeeping Data of the NOAA provided instruments ... received from the METOP satellite.	PIP Para. 2.6.1.3		X		X		X
1-10	Each party shall (10) control and operate its own Ground Segment	PIP Para. 2.6.2	X	X	X		X	

NOAA GROUND SEGMENT LEVEL 1 REQUIREMENTS ALLOCATION

		NOAA Ground Segment Elements						
Item Num.	Operational Requirement	Source	Command and Data Acquisition	Satellite Operations Command and Control	Data Processing and Distribution	Communications	Archive	Other
1-11	NOAA and EUMETSAT shall (11) undertake all necessary co-ordinations to ensure the day-to-day operations of their respective satellites and ground segment including the cross-support and blind orbit support tasks identified in section 2.6.1.2 and 2.6.3	PIP Para. 2.6.2				X		
1-12	NOAA and EUMETSAT shall (12) make available to each other the data collected by the IJPS (i.e. including the additional payload), ...	PIP Para. 2.6.3	X	X		X	X	X
	NOAA and EUMETSAT shall (12a) make available to each other all global data collected by their respective operational satellite for those orbits which are visible from their respective data acquisition stations: PCDA in Northern Europe for EUMETSAT, CDA stations in Fairbanks and Wallops for NOAA.	PIP Para. 2.6.3	X	X	X	X	X	

NOAA GROUND SEGMENT LEVEL 1 REQUIREMENTS ALLOCATION								
		NOAA Ground Segment Elements						
Item Num.	Operational Requirement	Source	Command and Data Acquisition	Satellite Operations Command and Control	Data Processing and Distribution	Communications	Archive	Other
	NOAA shall (12b) acquire the global data from the METOP-1 then from the METOP-2 satellites, for those orbits which are not visible from the EUMETSAT PCDA site, and shall (12c) make them available to EUMETSAT. The global data from the METOP-1 and METOP-2 satellites shall (12d) be made available under the form of Virtual Channel Data Unit (VCDU), decoded and with the corresponding quality flags appended. The NOAA Ground Segment shall (12e) be sized to provide blind orbit data acquisition to one operational EUMETSAT satellite; additional requests will be accommodated within that sizing.	PIP Para. 2.6.3	X	X		X		

NOAA GROUND SEGMENT LEVEL 1 REQUIREMENTS ALLOCATION

Item Num.	Operational Requirement	NOAA Ground Segment Elements Source	Command and Data Acquisition	Satellite Operations Command and Control	Data Processing and Distribution	Communications	Archive	Other
	EUMETSAT shall (12f) acquire the recorded data from the NOAA-N then from the NOAA-N' satellites, for those orbits which are not visible from the NOAA CDA station, and shall (12g) make them available to NOAA. The global data from the NOAA-N and -N' satellite shall (12h) be made available at raw data level, i.e. data shall be as received from the satellite. The EUMETSAT Ground Segment shall (12i) segment shall be sized to provide blind orbit data acquisition to one operational NOAA satellite; additional requests will be accommodated within that sizing.	PIP Para. 2.6.3		X	X			
	The data shall (12j) be made available to the other Party in a timely fashion to ensure the processing of the data from orbit N before starting the acquisition of orbit N+1	PIP Para. 2.6.3	X	X		X		
	The data acquisition stations shall (12k) ensure a rolling archive of 7 days of the satellite data acquired at the station.	PIP Para. 2.6.3	X				X	

NOAA GROUND SEGMENT LEVEL 1 REQUIREMENTS ALLOCATION

		NOAA Ground Segment Elements						
Item Num.	Operational Requirement	Source	Command and Data Acquisition	Satellite Operations Command and Control	Data Processing and Distribution	Communications	Archive	Other
1-13	The NOAA and the EUMETSAT Ground Segments shall (13) provide the following functions:	PIP Para. 2.6.4						
	data ingestion and pre-processing for the recorded data from both the "morning" and the "afternoon" satellites (i.e. sorting of the data, earth location and appending or application of the calibration coefficients, and performance of the associated quality control);	PIP Para. 2.6.4			X			
	distribution to the respective user communities of the pre-processed global data from both the morning and the afternoon satellites;	PIP Para. 2.6.4			X	X	X	
	generation of derived products, as requested by the respective user community, from the global data of both the morning and the afternoon satellites;	PIP Para. 2.6.4			X			
	distribution of the derived products, to the respective user communities; a subset of the products generated by each Ground Segment will be forwarded to WMO users via the GTS;	PIP Para. 2.6.4			X	X		

NOAA GROUND SEGMENT LEVEL 1 REQUIREMENTS ALLOCATION

Item Num.	Operational Requirement	NOAA Ground Segment Elements Source	Command and Data Acquisition	Satellite Operations Command and Control	Data Processing and Distribution	Communications	Archive	Other
	monitoring of the performance of the instruments, carried on their respective spacecraft, and of the data and product generation process by the respective Ground Segment;	PIP Para. 2.6.4			X			
	maintenance of instrument calibration databases;	PIP Para. 2.6.4			X			
	archiving of all global data and associated data bases, from both the morning and afternoon satellites, plus all the products generated by the respective ground segments.	PIP Para. 2.6.4					X	

Appendix B

Project Schedules

(To be Competed)